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Future Constructions Using Renewable Energy

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Abstract: The risks posed by the December 2004 Tsunami by its expectations through rehabilitation measures have tuned the whole world for permanent solutions. The relief works for the Tsunami have been effectively made for all the severely affected countries involving many Governmental and Voluntary organizations. The damages caused by means of lives and belongings could not be completely compensated, but counter acted satisfactorily to a desired level which could also be subsequently followed. Among the measures taken for the rehabilitation of those communities belonging to twelve different countries, the management of basic needs like drinking water supply and house construction were made in a phased manner but not satisfactory for long standing to some of the countries. This paper presents an innovative plan of providing permanent solution for such activities using innovative methods and renewable energy sources which can also be made for multipurpose utilization. An ideally suitable self sufficient scheme was worked out for implementation to a nearby Tsunami relief area of east coast, 10 km from Annamalai University and presented in brief.
Keywords: Renewable energy sources-Desalination- Solar power- Wind power.

Introduction

Human settlements have often started around rivers, lakes, bays and shore giving importance to Water, but frequent floods in India have forced the government to vacate people form river banks. The December 2004 Tsunami has totally changed the concept not to live near any rural coastal line. The post tsunami management brought multi phases of measures to be implemented for the affected community and the water supply and power supply problems have been typically dealt elsewhere. Necessity arises for permanent solution to arrive by some alternatives. Such level of thinking can promote some appropriate technologies utilizing renewable energies like Wind power, Solar power, Wave and Tidal power, geothermal energy, Bio fuel and hydro-electricitysolar, wind, tidal, wave and power.

Renewable Energy

In small island nations, the benefits of using renewable energy sources include self-sufficiency, minimal environmental impacts, and improved nutrition and sanitation, which result from the greater availability of desalinated water and mariculture products. Plants installed of these could provide islanders with much-needed power, as well as desalinated water and a variety of mariculture products. It will be worth knowing the potentials of renewable energy source worldwide captured from nature.

Wind power has a worldwide installed capacity of 74,223 MW and is widely used in several European countries and the United States. India is in the 4th place for using the Wind energy as shown in **the Table 1.** The installed wind mills / wind turbines in certain countries are shown in figure 1. Three bladed turbines is the most common design of modern wind turbines because it minimizes forces related to fatigue.

Table Wind power capacity (MW)

Rank	Nation	2005	2006	Latest
1	Germany	18415	20622	21283
2	Spain	10028	11615	12801
3	USA	9149	11603	13885
4	India	4430	6270	7231

(a) Wind farm in Galicia, Spain

(b) Muppandal, Tamilnadu in India

(c) La Mancha, Spain
(1605 novel Don Quixote)

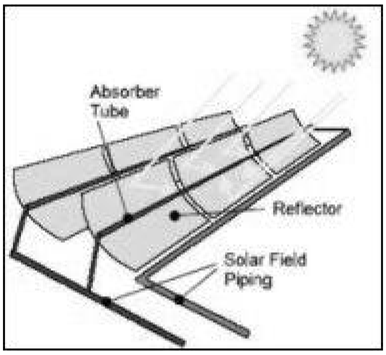
(d) Roof mounted Small scale wind power (12 V)

Fig.1 Wind Mills/ turbines

A rooftop mounted small scale wind turbine shown in figure1 (d) can charge a 12 volt battery and run various 12 volt appliances within the building of rural area on which it is installed. Wind turbines have been used for household electricity generation in conjunction with battery storage over many decades in remote areas. Increasingly, U S consumers are using grid-connected turbines in the 1-10 kilowatt range to power their whole homes. Household generator units of more than 1 kW are now functioning in several countries, and in every state in the U.S small wind generation systems with capacities of 100 kW or less are used to power homes, farms, and small businesses. Isolated communities that otherwise rely on diesel generators may use wind turbines to displace diesel fuel consumption. Individuals purchase these systems to reduce or eliminate their electricity bills, or simply to generate their own clean power.

Solar thermal power stations operate in US and Spain, and the largest is the 354 MW power plants in the Mojave Desert. The energy in sunlight is in the form of electromagnetic radiation from the infra-red (long) to the ultraviolet (short) wavelengths. The solar energy striking the earth's surface at any one time depends on weather conditions, as well as location and orientation of the surface, but overall, it averages about 1kW watts per square meter on a clear day with the surface directly perpendicular to the sun rays. Solar collector is a device that extracts the energy of the sun directly into a more usable or storable form. The best designed solar collectors are the ones that collect the most solar, and glazing is a common process used to increase the absorption rate of solar. Solar energy can run the refrigerator which is better than an electricity usage. Solar cooker and solar drier can be of direct use by individual families.

There are several types of solar collectors like Flat-plate collectors as shown in figure 2, Evacuated-tube collectors, Integral collector-storage systems(ICS) where solar heat is used to generate electricity by heating water to produce steam and driving a turbine connected to the electrical generator. A solar collector can be provided over the water tank of an individual house, but a roof mounted solar collector over an inclined roof is more advantageous. Solar collectors can be mounted on a roof but need to face the sun, thus a north-facing roof in the southern hemisphere and a south-facing roof in the northern hemisphere are ideal. Collectors are usually angled to suit the latitude of the location. Where sunshine is readily available, a 2 -10 square meter array will provide all the hot water heating required for a typical family house. Such systems are a key feature of sustainable housing, since water is usually the largest single consumer of energy in households.



(a) Parabolic trough

(b) Solar Parabolic dish

(c)ICS Home (Nevada)

(d) Roof with solar collectors

(e) Bahn Klong Kla (Pulao Katum, Malaysia)

Fig.2 Solar collectors in existence

ICS systems are simple, reliable solar water heaters. However, they should be installed only in climates with mild freezing because the collector itself or the outdoor pipes could freeze in severely cold weather. Some recent work indicates that the problem with freezing pipes can be overcome in some cases by using freeze-tolerant piping in conjunction with a **freeze-protection method.** Integral collector-storage systems, also known as ICS or batch systems, are made of one or more black tanks or tubes in an insulated glazed box. Cold water first passes through the solar collector, which preheats the water, and then continues to the conventional backup water heater. The home in Nevada as shown in figure has ICS system to provide hot water.

Solar Thermal Energy Group

Solar thermal energy group has innovative design for solar homes. One example is shown in figure 3. There's no chimney on this house, This simple one story hexagonal solar home is 32 ft in diameter, has a full basement, a 1000 gallon heat storage vault and a 250 sq. ft. solar thermal roof. This house is a bit more conventional. It's based on a Harry E Thompson's Trickle Down solar thermal roof system but it's been modified to for easy installation on top of an existing roof.

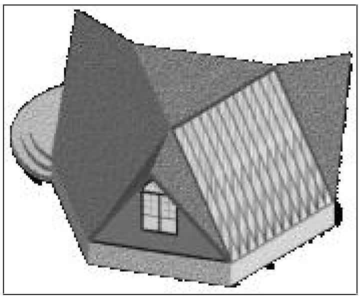


Fig. 3 Solar home

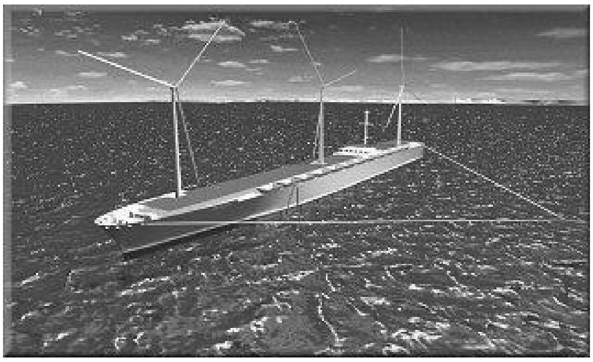
Seawater Desalination

Seawater Desalination refers to process that removes excess salt and other minerals from water. Sailors have been using solar evaporation to separate salt from sea water for at least several thousand years. But the modern interest in desalination is focused on developing cost-effective ways of providing fresh water for human use in regions where the availability of water is limited or no water is available. Most of the world's 1500 or so desalination plants used distillation as the process. There are more than fifteen methods very expensive, however, an exploding world demand for potable water has led to a lot of research and development and a new, cheaper process has been developed that involves heating sea water and forcing it through membranes to remove the salt from the water.

An Australian company (Seadov Pty Ltd) has come up with an eco-friendly desalination plant shown in figure 4 during the middle of 2007 to be an innovative Green Marine technology. A combination of wave, tidal, solar and wind energy devices were integrated into an off-shore vessel to power an on-board reverse osmosis desalination system and its associated ship-to-shore pipeline pumping system. This can generate cost-effectively enough potable water to end water restrictions in most coastal cities of the world. A similar technology can be appropriately applied with a simple floating system anchored to sea bed in the shore of the Tsunami affected area as a permanent water supply system.

The large energy reserves of many Middle Eastern countries, have led to extensive desalination plants. Saudi Arabia's desalination plants account for about 24% of total world capacity. The world's largest desalination plant is the Jebel Ali Desalination Plant in the United Arab Emirates uses multi-stage flash distillation and is capable of producing 300 million cubic meters of water per year. The largest desalination plant in the United States is the one at Tampa Bay, Florida, which began desalinizing 25 million gallons of water per day in December 2007. The Tampa Bay plant runs at around 12% the output of the Jebel Ali Desalination Plants. An article of January

17, 2008 in the Wall St. Journal states, World-wide, 13080 desalination plants produce more than 12 billion gallons of water a day, according to the International Desalination Association. At Hawaii's Seacoast Test Facility, which was established as a joint project of the State of Hawaii and US Department of Energy (DOE), desalinated water was produced by using the open-cycle process.



SEADOV : Desalination On Vessel

Solar Sailor water supertankers

Fig.4 Desalination plants

Onshore and Inland Installation

Shore line dwelling units are supplied with pipe line water from a considerable distance where deep well yields potable water. The desalination plants if installed individually or collectively can compensate the water scarcity. In 1981, Japan demonstrated a shore-based, 100-kWe closed-cycle plant in the Republic of Nauru in the Pacific Ocean. This plant employed cold-water pipe laid on the sea bed to a depth of 580 meters.

Recent applications

A barge mounted desalination Plant of capacity 1000 m^3/day was successfully commissioned off the coast of Chennai during April 2007 by the National Institute of Ocean Technology (NIOT) using Low Temperature Thermal Desalination (LTTD) process. The plant runs on the principle of LTTD that involves flash evaporation of sea surface warm water (27-30˚C) under low pressure in a flash Chamber maintained under Vacuum and consequently liquefying the resulting vapour in a Condenser. A 500 m long pipe is deployed in the ocean to draw the cold water (at about 10˚C) from a depth of about 450 m. The entire plant and mooring was designed by NIOT and manufactured and installed indigenously. LTTD Technology can also be used to produce potable water using temperature differential of surface sea water and the water discharge from waste heat recovery unit of power plants located near sea shore. The central government has sanctioned for sea water desalination plant to Nemeli (near Chennai City) which has started functioning.

Need of the Hour

It has been realised by all parts of the countries to have polluted water at shallow and medium depths as brackish ground water. Water supply by deep bore wells causes ecological imbalance. Under such situations as the inland water at shallow depths has typically about one-tenth the salinity of sea water, desalination can be accomplished more easily and transportation is less of an issue. However, major advantage of desalination of ocean water is that water is always available even in the most severe droughts. It is to be appreciated that Government of Tamil Nadu had provided totally 26862 homes to the Tsunami affected community. The Tsunami affected area is actually assumed to be given special focus and the over all development should include social, economical as well as political considerations. To achieve this, the relief measures should be a permanent one and based on self sufficient nature, so that the follow up could be with least budget.

Proposed Scheme

MGR Thittu in Cuddalore district is one of the worst affected villages (Island) and **Muzhukuthurai** also. These sites are in low lying areas as shown in figure 5, next to the backwaters and between the Vellar and Kollidam rivers. This area requires a regional study of Chidambaram-Killai corridor which is fast developing and is mostly passing through low lying areas. For avoiding floods in MGR Thittu and Muzhukuthurai it is recommended that the road from Killai to these sites have enough bridges was water to pass through under it.

The regional drainage slope seems to be from north-west to south-east (see black/white imagery below). Once the water is allowed to pass under it, the water won't be flowing towards these sites. Also the extended section of the road from Muzhukuthurai to MGR Thittu (new relocation site) which goes parallel to the coast (backwaters) should also have opening for water to pass through.

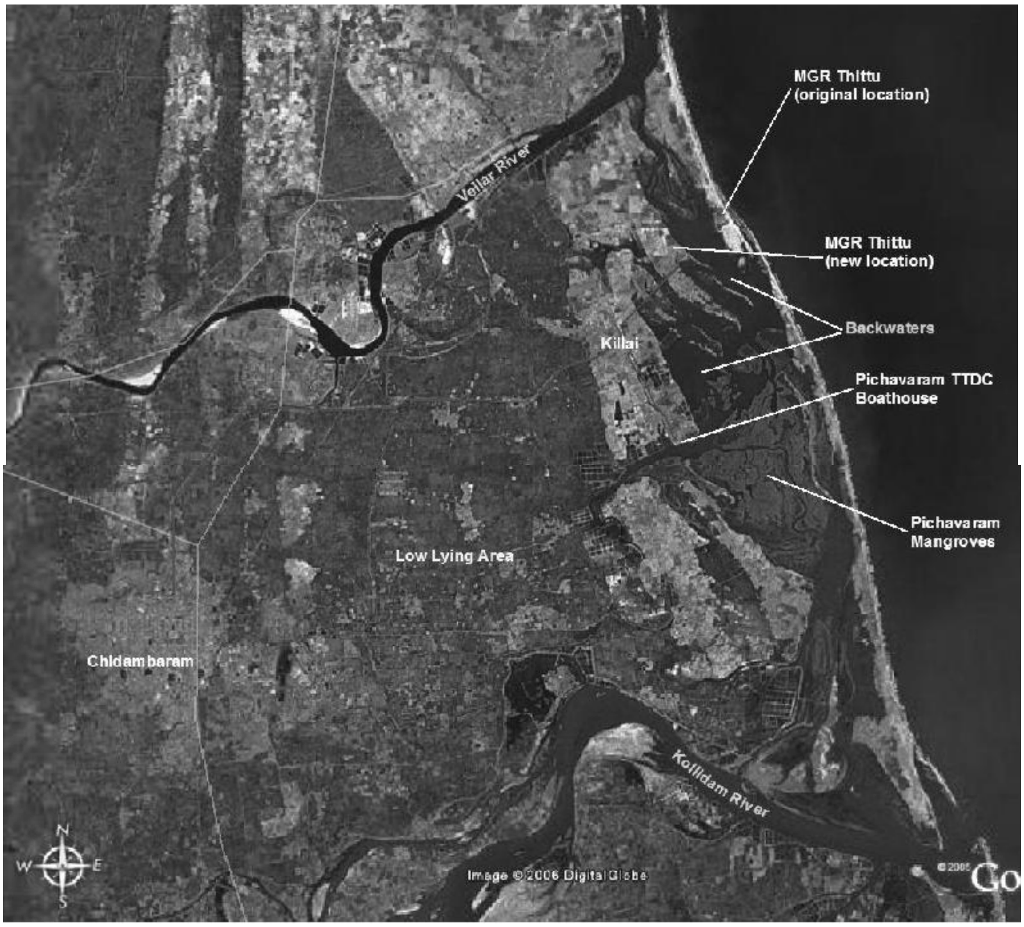


Fig.5 Backwaters / low lying areas between Kollidam & Vellar Rivers

The proposed layout of group housing for a Tsunami affected area near Annamalai University is shown in Figure 6. One of its first orders of layout which is simple is shown. In another layout, twin type houses are proposed which has more than 10% saving in the overall construction cost of two individual houses. In order to have a smooth transfer from the past way of living style to a totally new one for the affected community, a self sufficient home was proposed by the authors.

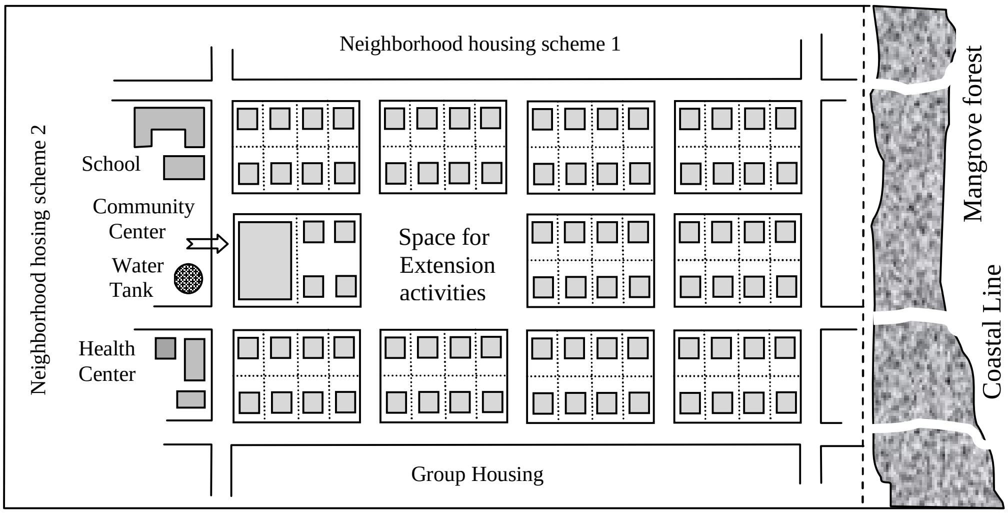


Fig.6 Housing Schemes with common facilities at ≈ 500 m from shore line

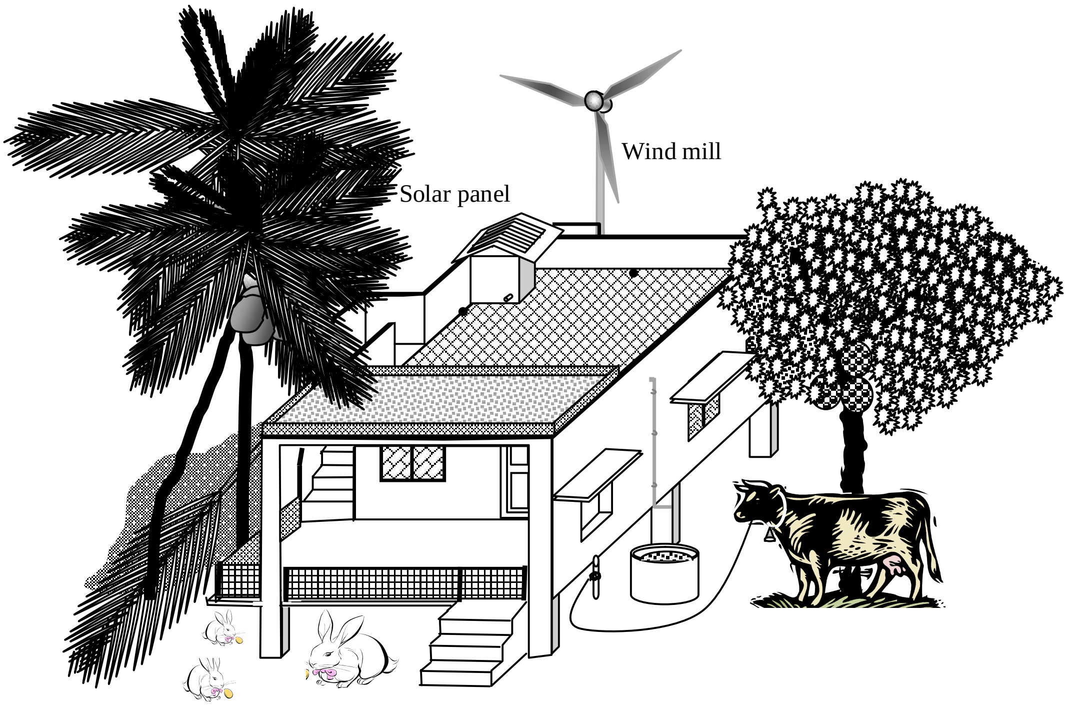


Fig.7 An ideal home which exploits Non conventional energy

More appropriate to a remote rural coastal area of Tamil Nadu, the features as illustrated in figure 7 are explained below:

1. The projection of the house from the ground level is the added advantage, by which the waves can pass through and recede, if the units are located very close to the coastal line or the waves are drawn to inland. The projection may be from 1m to 1.5m depending on the locations leading to multipurpose utilisation for other cultures.

2. The reinforcement corrosion is a problem always faced by the construction industries and the corrosion protection considerably increases the overall cost. As the problem is very serious in the coastal line, a novel idea has been proposed here to use the optimum amount of steel that too with heavy protection avoiding the major consumption of steel. To be more technical, the foundation, the columns and the base slab will be of conventional reinforced concrete with protected steel over which only masonry and other cost effective systems are raised. The innovations include the use of flyash in the form of bricks/blocks and frames (replacement for costly timber) and non corrosive concrete reinforcements. The Neyveli Lignite Corporation (NLC), situated at 50km from the coastal line produces a large quantum of flyash as a waste/by product. Technology on small and large scale production of such flyash based products have been made available.

3. This self sufficient home by its provisions can capture wind energy through turbines, solar energy through solar collector and utilize both for desalination of saline ground water, dry fish processing and cooking. Refrigeration(for ice making used for packing to export), water desalination, aqua culture and fish processing, rearing of cattle, goats and poultry, garden maintenance can be thought, using conventional energy for a self sufficient home. The All India Movement (AIM) for Seva has already installed desalination plants in three villages of Thiruvallur District, which was contributed by United Kingdom, Germany and France. In another way, fishing women's Self Helping Group (SHG) of Sonankuppam has started solar dry fish business after getting an appropriate training. After the Tsunami, District linkage of Rs.1.00 lakh was given to this SHP. This group is getting an income of Rs. 1000/ month per member, doing fish business. Mushroom business has also been encouraged irrespective of community to have an income of Rs.2000/month/ family in the combined region of the coastal line.

Conclusion

In the 21st century, even the settlement may one day be concentrated around moving water, allowing communities to manage power themselves with non-polluting energy from nature. Future has to depend on renewable energies. The proposed model made is feasible for the effective management of coastal community which is also very much viable. The technical details of using typical renewable sources, fabrication of capturing units, their cost analysis and comparison are available with the authors. As the technology has been in existence even in the developed countries this will be an alternative to the developing countries like India for the management of the coastal community.

The recent desalination plant installation at Chennai being the first of its kind in the state, if extended to other remote areas, the water problem will be significantly reduced. As a large number of donors from abroad are willing to contribute much for the affected communities for their rehabilitation, the proposed model can promote a proactive type of Tsunami management. However, commitment and involvement with honesty are highly required for efficient and successful management.

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